NASA STTR 2014 Phase I Solicitation

T12.02 High Temperature Materials and Sensors for Propulsion Systems

Lead Center: GRC

Participating Center(s): AFRC, ARC, LaRC, MSFC, SSC

Advanced high temperature materials, structures and sensors are crosscutting technologies which are essential in the design, development and health maintenance/detection needs of components and subsystems that will be needed in future generations of aeronautical and space propulsion systems. The extreme temperature and environmental stability requirements posed by aerospace propulsion systems requires material improvements to meet the challenges of systems of the future. Increased temperature capability can be achieved through the development of new and improved materials as well as through innovative designs, with both materials and designs dependent on advanced processing techniques. The combined effect of environment plus mechanical/thermal loading is expected to have a greater degree of influence on the durability of aerospace high temperature materials. Nanotechnology offers a means to develop higher-temperature/environmentally-resistant structural materials with engineered microstructures that can optimize material properties for propulsion hot section components. Multifunctional materials and structures offer a means to reduce component weight in aerospace flight vehicles, enabling efficiency, performance improvements and reduced fuel burn for aircraft and greater payload mass and launch cost reduction for spacecraft. The small volume and high force-to-weight ratio of shape memory alloys are an attractive actuator replacement for current ones based on electric motors, hydraulic or pneumatic systems. Sensing methods and measurement techniques that are cost-effective and reliably assess the health of aerospace engines and vehicle components in harsh high-temperature environments (to 3000 °F) allow for a proactive approach to maintain capability and safety. Proposals are sought to:

- Develop innovative approaches to enhance the processability, performance and reliability of advanced high temperature materials, including metals, ceramics, polymers, high-strength fibers, composites, hybrids and coatings to improve environmental durability for engine components.
- Develop innovative methods, evaluate and model the impact on the mechanical properties of representative aerospace materials tested while resident in the extreme application environment, to compare to mechanical property testing in air or in vacuum.
- Demonstrate novel processing approaches (simpler, more cost effective) for advanced aerospace materials for propulsion systems.
- Develop physics-based modeling tools to predict durability and life based on damage mechanisms of advanced materials.